1C29

Modeling of the Feedback Stabilization of the Resistive Wall Mode in Tokamaks*

M. S. Chance,[a] M. S. Chu,[b] A. H. Glasser,[c] M. Okabayashi[a] and F. W. Perkins.[a]

[a] *Princeton Plasma Physics Laboratory, Princeton, New Jersey.*
[b] *General Atomics, San Diego, California.*
[c] *Los Alamos National Laboratory, Los Alamos, New Mexico.*

Abstract

We have extended our model of the feedback stabilization of the RWM in tokamaks to incorporate feedback coils internal to the resistive vacuum vessel in accordance with the corresponding modification of the DIII-D device at General Atomics. These new coils add much more flexibility to the feedback capabilities, but at the same time add more complexity to the analysis. Whereas the external coil current path of the previous configuration was designed to primarily sustain the stabilizing eddy current in the shell, the field, $\vec{B}_{\text{coil}}$ of new internal coil configuration, can be tailored to more directly affect the plasma with the appropriate stabilizing $\vec{J}_{\text{plasma}} \times \vec{B}_{\text{coil}}$ forces. The previous analysis using a normal mode approach with the DCON-VACUUM [1, 2, 3] codes is extended for this study. It includes an assessment of various feedback and sensor coils configuration. Results of this study showing specifically the impact of the internal coils will be presented and compared with results from other models, e.g., the VALEN code [4]. Recent experimental results from DIII-D with the external feedback coil indicate that plasma rotation contributes significantly to maintaining the stability of the plasma during the course of feedback experiments. The rotation is however impeded by the presence of an external error field which interacts resonantly with the resistive wall mode [5, 6, 7]. Stability of a rotating plasma can only be studied using a formulation other than the normal mode approach, such as the MARS code [8]. We have thus embarked on enhancing the capabilities of the MARS code to study the response of the plasma to an externally imposed magnetic perturbation. This response will be compared with experimental measurements to investigate the loss of plasma rotation induced by the error fields.

References

[1] M. S. Chu, M. S. Chance, A. H. Glasser and M. Okabayashi, GA-A24048 (2002). Submitted to *Nuclear Fusion.*

[2] A. H. Glasser, and M. S. Chance, *Bull. Am. Phys. Soc.* **42**, 1848 (1997).

[3] M. S. Chance, *Phys. Plasma* **4**, 2161 (1997).

[4] J. Bialek, A.H. Boozer, M. E. Mauel, and G. A. Navratil, *Phys. Plasmas* **8**, 2170 (2001).

[5] A. H. Boozer, *Phys. Rev. Lett.* **86**, 5059 (2001).

[6] A. M. Garofalo, et al., *Phys. Plasmas* **9**, 1997 (2002).

[7] M. Okabayashi, et al., *Plasma Phys. and Control. Fusion* **44**, 339 (2002).

[8] Y. Q. Liu, and A. Bondeson, *Phys. Rev. Lett.* **84**, 907 (2000).

*Work supported by U. S. Department of Energy Contract No. DE-AC02-76-CH03073, and U. S. DoE grant No. DE-FG03-95ER54309 and DE-FG03-94ER54271.